Propagation of Plants From Cuttings Using Rooting Solutions by Foliar Methods©

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INTRODUCTION

To be efficient and competitive it is necessary to use effective methods. In propagation, the goal is produce high quality and high yield production. Material cost must be minimized. It is also important to select labor-saving methods that assure all plant materials are properly treated.

I have never completely read a whole book on plant propagation nor a complete chapter. I did however read a popular book on nursery management. Written in '96, the esteemed writer explains that the best way to propagate a plant is to use its natural reproduction ability. Perhaps you own this popular book, the Nursery Book, written by Liberty Hyde Bailey, not 1996 but 1896, more than 120 years ago. He did not discuss plant rooting substances since scientists had not yet identified them (Bailey, 1896).

Contemporaries of Bailey, Darwin, and other scientists, identified the polar transport of natural substances from the apical part of the plant downward. Plant researchers had long known that plants produce substances that cause dormant cells to divide and become roots. In 1934, Thimann and Went identified the substance to be IAA (indole-3-acetic acid), a plant growth regulator, now called an auxin. Scientists soon proved the ideas of Darwin. Plants produce auxins in leaves (Thimann, 1977; Darwin, 1880). The auxins move from the apical to the basal part of plant cuttings. Foliar application of bio-simulators of the natural auxin travel like the natural auxin. When used for root initiation, the threshold amount of all auxins are accumulated and utilized at the basal end.

Methods to apply auxin solutions to the leaves of plant cuttings will be discussed. Using readily available equipment, these methods assure all cuttings are properly treated using minimum labor and materials.

AUXIN METABOLISM

The natural auxin, indoleacetic acid (IAA), produced during the development of leaves, is found in free and bound states.

Free auxins are available immediately. They move within the plant in polar transport, from the elongating leaf tips and continue downward, through the vascular system, to the basal end (Aloni, 2004). Free auxins are present when auxins are dissolved in water to make auxin solutions.

Bound auxins are variable and limited in their ability as plant growth regulators. Bound auxins are present when auxins are made into dry powder (often called "rooting hormones") and blended with lanolin. Bound compounds, applied close to the basal end, do not need polar transport to initiate roots since they are close to where roots are to be formed (Fig. 1) (Leopold, 1955).

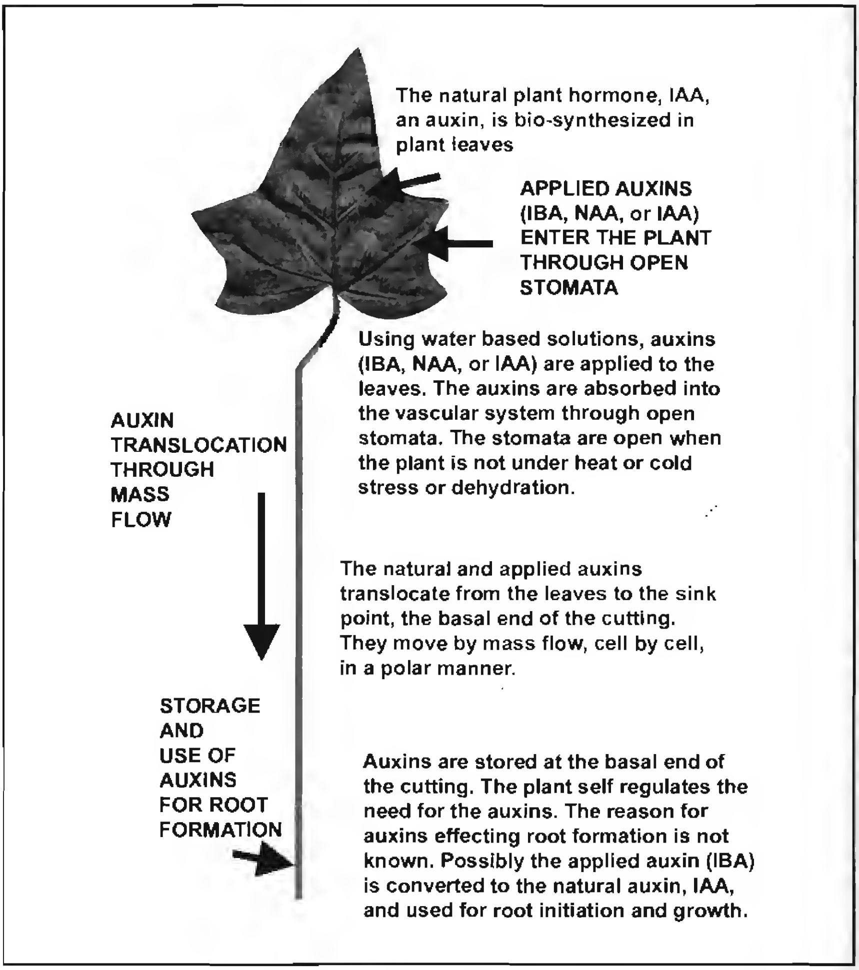


Figure 1. Route of foliar applied rooting solutions that contain auxin for use in root formation. (All graphics by Hortus USA.)

BIO-SIMULATORS OF THE NATURAL AUXIN

The natural auxin, IAA, is unstable and degrades rapidly in the presence of light and heat. More stable than IAA, the bio-simulators IBA (indole-3-butyric acid) and NAA (naphthalene acetic acid) are commercially available. They remain active for use by plants over a long time. They are regulated by the plant for many purposes, including inducing root formation. Scientists do not fully understand the way that plants use auxins to induce root formation. As of 2009, as single component auxin, only IBA is U.S.A. EPA registered. In Europe all three are registered in several countries [Note: some international registrations as single component auxin rooting products: IBA: U.S.A. (U.S.A. EPA registered); IBA, NAA, and IAA: Holland,

UK, Ireland, Slovenia, Poland, Czech Republic; IBA: Slovenia; NAA: Ireland (Rhizopon correspondence)]. Of the three, IBA is the most useful auxin to propagate plants from cuttings by inducing root formation. For plant propagation, several basal and foliar auxin application methods are used. The methods and rates depend upon plant type, juvenility, season, and other factors (Rhizopon, 2004).

For this discussion, the following definitions are used:

- **Auxin solution:** any solution made by dissolving auxin in a solvent. These solutions are used by various methods for any plant growth regulation function.
- **Auxin rooting solution or rooting solution:** any solution made by dissolving auxin in a solvent. These solutions are used by various methods to induce root formation.
- **Aqueous solution:** a solution made using water as the solvent.

POLAR TRANSPORT

Produced in leaves, plants transport IAA, and other auxins, cell to cell, to the basal end. The plant regulates the speed of motion based upon physiological factors, such as water status. Relative rates of movement are: IAA at 7.5 $mm \cdot h^{-1}$, NAA at 6.7 $mm \cdot h^{-1}$, and IBA at 3.2 $mm \cdot h^{-1}$. The rate of flow is not critical since auxin use is slow (Epstein, 1993). As the auxins travel they accumulate in higher concentrations at the basal end (Figs. 2 and 3) (Thimann, 1977).

Two physiologically distinct and spatially separated pathways function to transport auxins over long distances through plants, the polar and nonpolar routes.

In the polar route, auxin is translocated by mass flow and other metabolites in the mature phloem. Transport is downward from immature tissues close to the shoot apex toward the root tips. In aqueous solution, free auxin, loaded into a mature phloem, is translocated passively in the phloem sap to sink organs and tissues at the basal end where it is released (Aloni, 2004). Free auxin moves in the primary shoot through the epidermis, bundle sheath, vascular meristem, and xylem. In the secondary body through the phellogen and cambium. In the primary root through the epidermis, pericycle, and vascular meristem.

In the nonpolar route, auxins move up and down the sieve tubes (Aloni, 2004). Upward flow is apparent when there is an excess of auxins beyond the threshold level needed by the plants, sometimes causing aerial roots to form (Fig. 4) (Thimann, 1977).

AUXIN METABOLISM AT THE BASAL END

IBA was shown to be metabolized by the plant to IAA in a slow-release process, thereby allowing steady use of the unstable IAA. Stable IBA was found to be an endogenous, synthesized, constituent of various plants. Like IAA, IBA is transported mostly in "basipetal direction polar transport," from apex to the base. Research by Epstein found that the plants studied were able to hydrolyze auxin conjugates during growth to time-release "free auxin" which may induce root initiation (Epstein, 1993). This theory is supported by Epstein's reports on increased level of free auxin in the bases of cuttings prior to rooting. Studied in grape and olive, the plants were shown to convert IBA to IAA, where, IAA was shown to accumulate at the basal end. The higher rooting promotion of IBA was also ascribed to its stability relative to IAA which is short lived, though, IBA was metabolized and used up in plant tissue (Fig. 5) (Epstein, 1993; 1984).

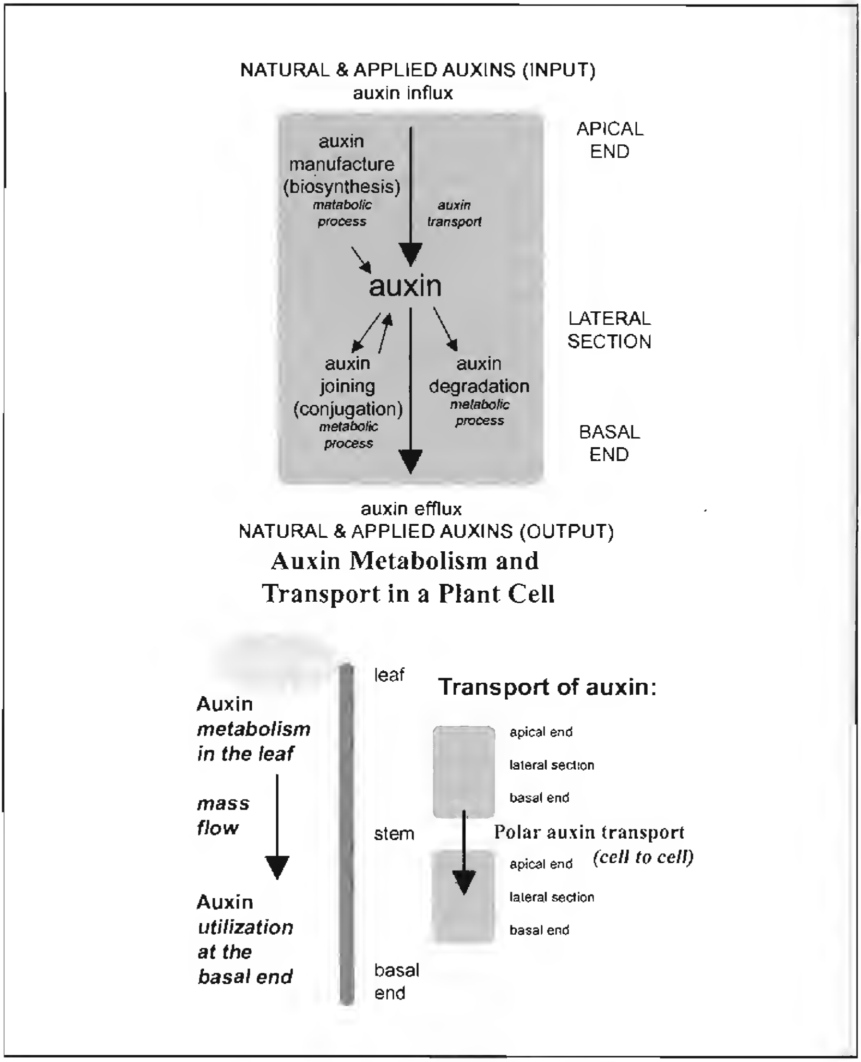


Figure 2. Auxin metabolism, transport, and utilization in a plant system.

AUXIN EFFECTS ON PLANTS (BASED UPON DAVIES, 2004)

Root formation effects of auxins:

- Cell enlargement (increase root and stem length).
- Cell division (assists in root formation).
- Root initiation (induces roots on stems and sometimes leaves).
- Apical dominance (effects the stem and leaf growth when using foliar applied auxins).
- Tropic responses, bending (sometimes noticed on tender leaves when using foliar-applied auxins).

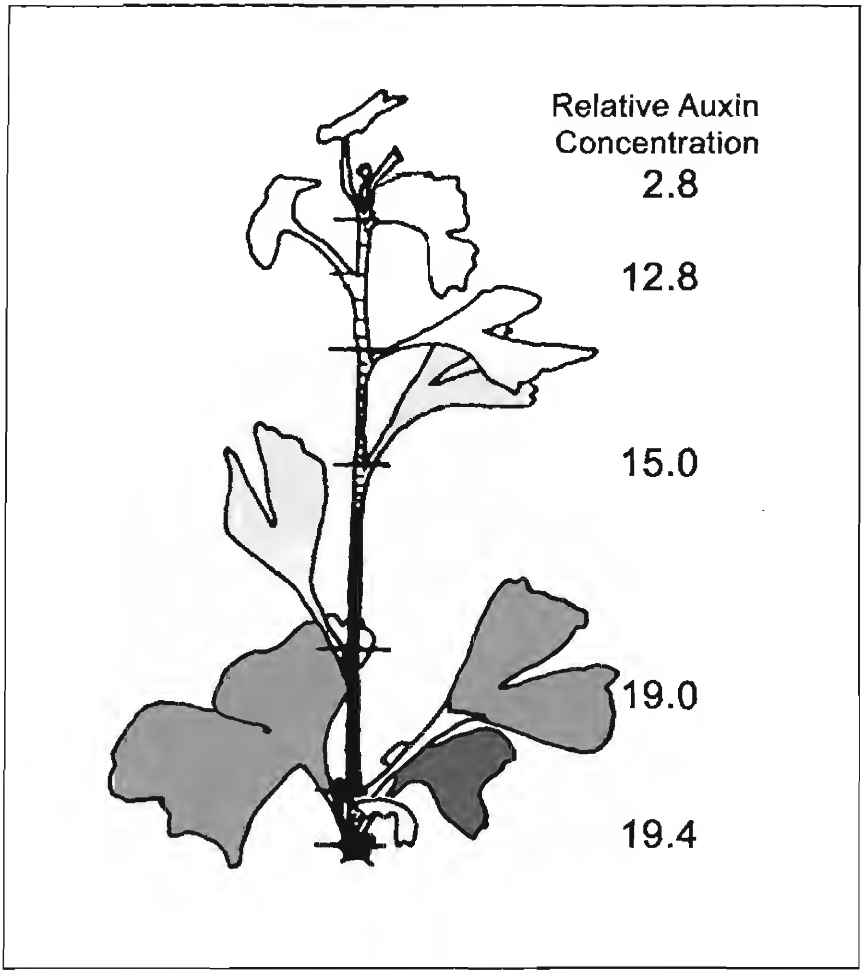


Figure 3. Distribution of auxin in *Ginkgo bilboa*. (Based upon Thimann: *Hormone action in the whole life of plants*, 1977, pages 173–177.)

Other plant growth effects of auxins:

- Leaf senescence (delay of leaf drop).
- Leaf and fruit abscission (leaf and fruit drop).
- Fruit setting and growth.
- Promotes flowering in some plants like bromeliads.
- Growth of flower parts.
- In some cases, the effect of excess auxins is to inhibit growth.

EARLY AUXIN APPLICATION METHODS

Due to technology, researchers in the 1930–40s were limited in their ability to make useful auxin compounds. Their auxins were difficult to make soluble in water. They were soluble in active solvents, like alcohol, that can be fatal to plant cells and cause plant and cutting mortality.

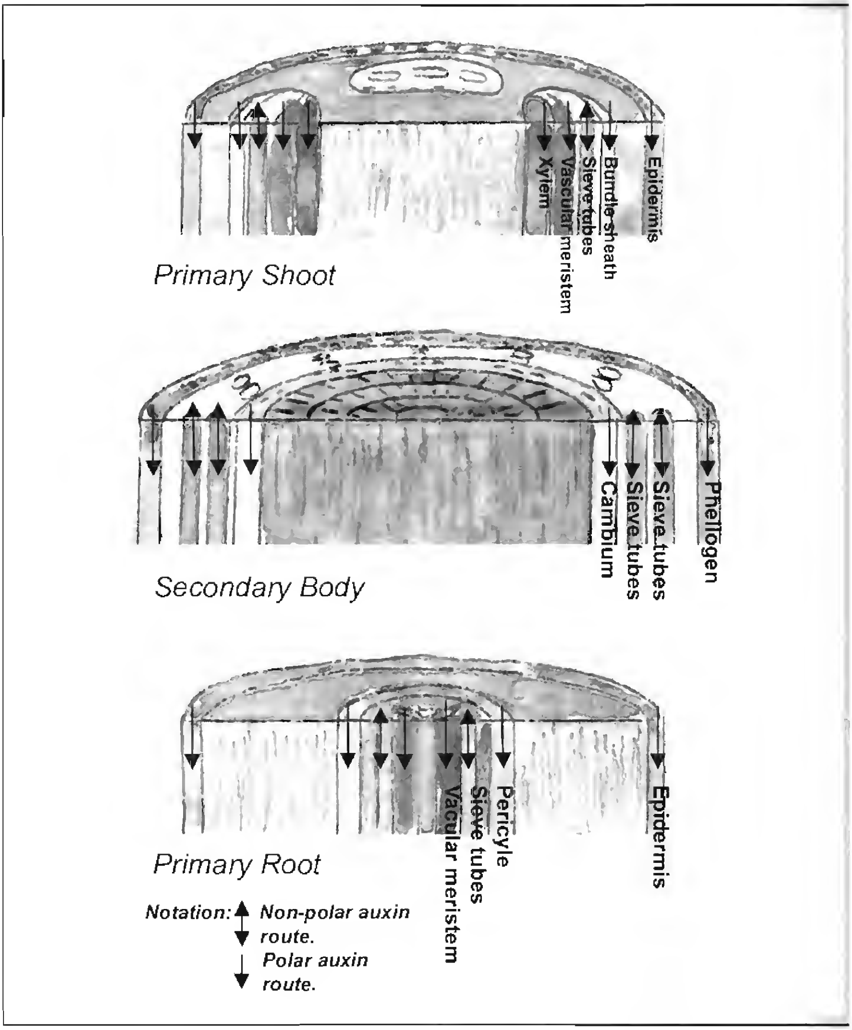


Figure 4. Free auxin transport in plant shoot, body, and primary root.

- **Auxin dry-dip powder compounds.**
  - Method: applied to the basal end of the cuttings.
  - Formulation: powders were made with auxins blended with talcum powder or powdered charcoal.
- **Auxin rooting solutions.**
  - Method: applied to the basal end of cuttings by basal long soaks.
  - Formulation: early auxin rooting solutions were made in low concentration using alcohol as carrier.

After 1939, tablets made by Rhizopon, in Holland, allowed auxin solutions to be made using water. These solutions were used for plant rooting and other plant

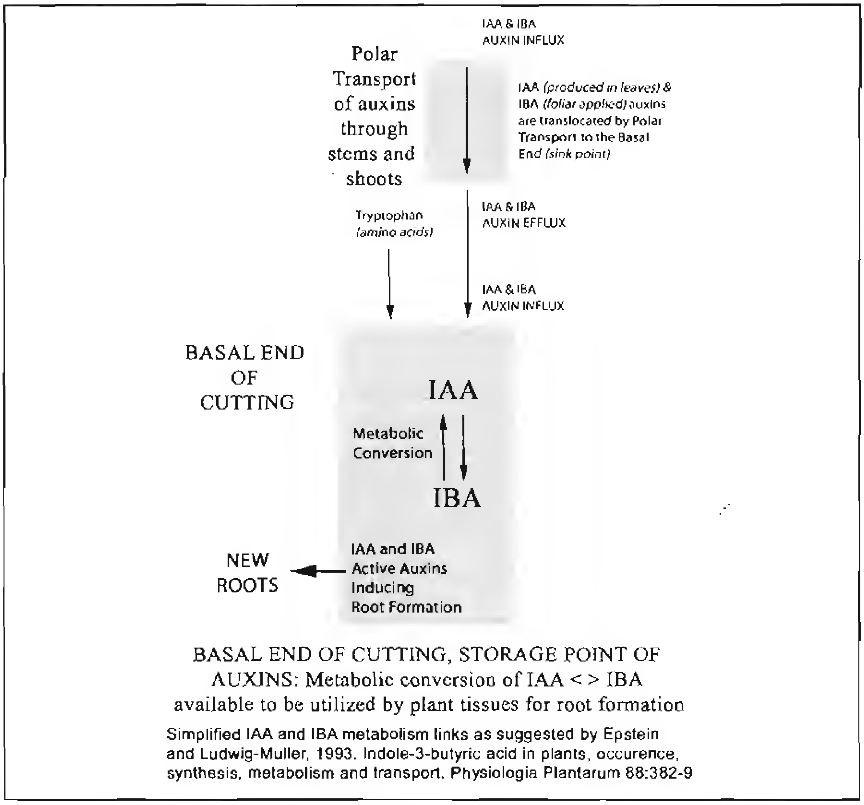


Figure 5. Auxin metabolism at the basal end of the cutting.

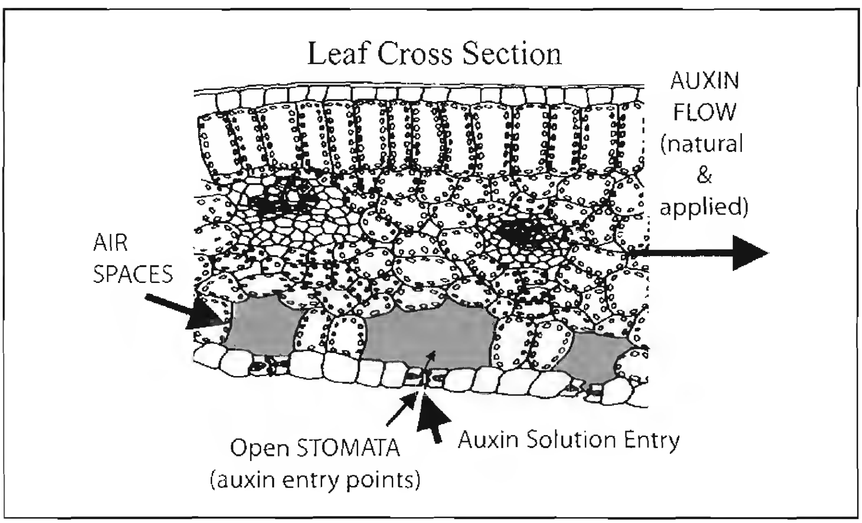


Figure 6. Leaf stomata and entry of auxins into the vascular system.

growth regulation operations. The tablets were available in Holland and did not have worldwide distribution for use by researchers.

- **Auxin lanolin paste.**
  - Method: applied to the basal end and also to plant leaves (Mitchell, 1947; Thimann, 1937).
  - Formulation: pastes were made with lanolin from wool blended with auxins.

EARLY FOLIAR OBSERVATIONS

In 1946, van Overbeek observed that the action of the natural plant rooting substance (IAA) in the leaves of plants is essential for plant cuttings to form roots at the basal ends. The rooting substances move from the leaves to the basal end where they are stored (van Overbeek, 1947). Thimann and Went, in their 1937 book, *Phytohormones*, discuss trials where they applied lanolin-auxin compounds to various parts of the plant. Application to the apex and also the basal end both had positive rooting effects. "When auxin is applied to the apex, the lowest concentration needed to produce localized roots in this way is about 100 times that needed to produce roots at the base" (Thimann and Went, 1937). Using viscous lanolin-auxin compounds they had "bound auxins" which had difficulty translocating to the basal end. Therefore, they needed high rates by apex application.

THE LEAF STOMATA AND ENTRY OF AUXINS INTO THE VASCULAR SYSTEM

Leaves have stomata, pores that allow the plant to transpire gases, oxygen, carbon dioxide, and liquids. The stomata are protected, each by two guard cells. These cells cause the stomata to be open during normal room temperature and close in heat or cold. Under the guard cells are air spaces. Aqueous auxin solutions contain "free auxins." The solution when applied to leaves enters open stomata and is entrapped in the air space. After entry, free auxins can flow through the vascular system (Fig. 6) (Leopold, 1955).

CONTEMPORARY FOLIAR METHODS

In 1985, Kees Eigenraam was the technical advisor for Rhizopon bv in Holland. He knew Rhizopon auxin products, made into aqueous solutions, regulate fruit and flower drop when applied to the leaves of plants. He found that auxin solutions applied to leaves had a positive effect on root initiation. He did trials at Dutch greenhouses where he developed two methods of application.

USING THE TOTAL IMMERSE METHOD (FIGURE 7)

- Cuttings are totally immersed in the rooting solution for 5 sec.
- The cuttings are then stuck in media.
- The cuttings require no further treatment.
- Dipping is usually done in a basket, with a few cuttings to avoid breakage.
- This method is especially useful for very small production lots. It is also good for large homogenous lots taken from a large parent stock.

Since the cuttings drag in biologicals, to avoid cross contamination of pathogens, the rooting solution should be disposed after 4 to 5 h of use, or at a minimum daily (Rhizopon, 2004; Kroin, 2009).

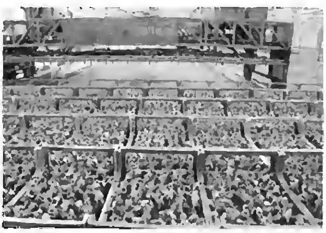
Total Immerse tank at a Dutch ivy rooting station. The dip basket is not shown.

Total Immerse Method

The cuttings are TOTALLY IMMERSED in an IBA water based rooting solution for five seconds.
Use a basket (optional).
- The cuttings are STUCK in media.
- The cuttings require no further treatment.

Dispose of solution after use.
Workers doing sticking do not individually treat the cuttings. The cuttings are all treated uniformly.

Figure 7. Total immersion method.



Robotic spraying at a Dutch chrysanthemum rooting station. This is not a traditional boom. Spraying is photo-optic controlled to assure uniform spraying.

Spray Drip Down Method

- The cuttings are STUCK in media
The cuttings are SPRAYED with an IBA water based rooting solution until liquid drips off the leaves.
Use a tank type sprayer: hand, backpeck or hydraulic.
Do not use booms or proportional mixers.
- The cuttings require no further treatment.

Misters are turned on after the leaves dry or after about 45 minutes. There is no cross contamination, the solution is used one time. Workers doing sticking do not individually treat the cuttings.

Figure 8. Spray drip down method.

USING THE SPRAY DRIP DOWN METHOD (FIGURE 8)

- The cuttings are first stuck in media.
- The rooting solution is sprayed onto the cuttings until the liquid drips off the leaves.
- Minimum labor skills are needed.
- During sticking no PPE is required since cuttings are untreated. PPE is only required during spray treatment.
- Tank mix sprayers are used (hand, backpack, or hydraulic). Boom sprayers do not provide good control and proportional mixers give inconsistent mixing.
- One skilled operator can treat large production areas in a few minutes.
- Misters can be turned on after the rooting solution dries on the leaves or 30 to 45 min.

In hot climates spraying is done early in the morning because stomata are open and accept the solution. The solution is used one time; there is no cross-contamination between crops due to the treatment (Rhizopon, 2004). The spray drip-down and total-immerse methods are labor saving since the workers do not individually treat the cuttings.

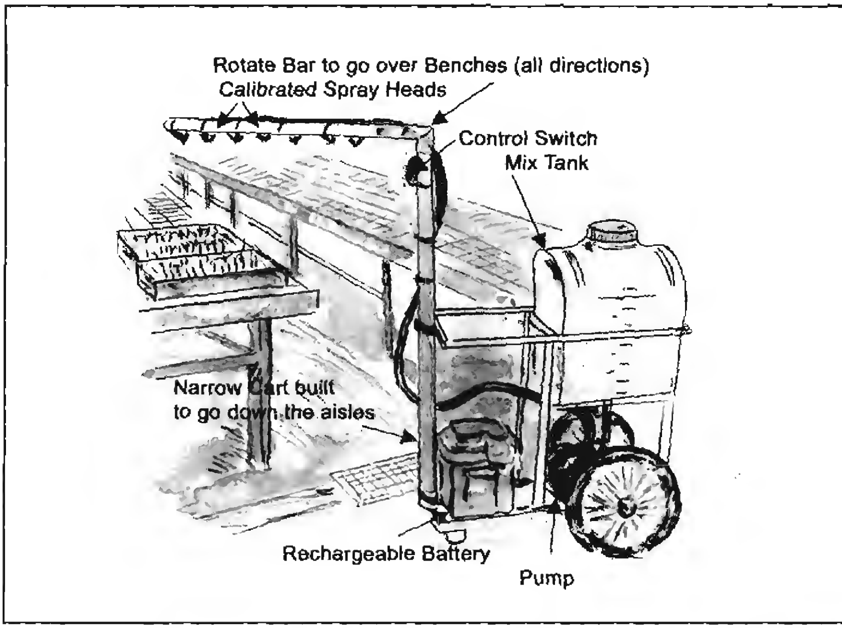


Figure 9. The Yoder-Greenleaf Perennials, Lancaster, Pennsylvania facility, made a spray cart to allow spraying on either side of the aisles.

YODER BROTHERS AND BAILEY NURSERIES ADOPT FOLIAR METHODS

In 1994, Kees and I visited Lyraflor in Holland, one of the world's largest chrysanthemum rooting stations. Lyraflor used robotics. The robots placed the trays of cuttings in the propagation house. They then sprayed the rooting solutions on the cuttings. We also visited pot rose and *Hedera* (ivy) growers who totally immersed the cuttings then stuck them (Kroin, 2009). These growers all used Rhizopon AA Water Soluble Tablets containing IBA.

In the U.S.A., Kees and I visited the Yoder Brothers chrysanthemum Florida stock plant facilities (now Syngenta Flowers). At that time they used rooting solutions by basal quick dip. We introduced them to foliar application. Water soluble IBA products were selected because they are U.S.A. EPA registered for use by plant growers. Soon after their Yoder-Greenleaf Perennials growers (now Aris Horticulture, Green Leaf Plants div.) did foliar trials on their perennials. They adopted the Spray Drip Down Method using Hortus IBA Water Soluble Salts (Yoder, 2004; 2008–2009).

A few years later Sam Drahn at Bailey Nurseries developed a program using the Spray Drip Down Method on woody ornamental plant cuttings using Hortus IBA Water Soluble Salts (Drahn, 2003, 2007). The Bailey trials were innovative since the technique had been previously used mostly on annual and perennial cutting. Sam began his trials with high concentrations of rooting solutions made with the salts (Drahn, 2003, 2007). Later he found that lower rates also achieved good rooting (Drahn, pers. commun.).

Yoder, Aris, and Bailey developed spray methods suited for their operations. Both companies do sticking all day and spray the next work day, even after a weekend.

The Yoder-Greenleaf Perennials, Lancaster, Pennsylvania facility, made a spray cart to allow spraying on either side of the aisles. Bailey Nurseries plant their cuttings in beds or pots; they spray the cuttings using a hydraulic sprayer.

FOLIAR RATES (REFER TO CHARTS)

Perennial and Woody Ornamental Plants. While Yoder and Aris produce perennials and Bailey produces woody ornamental plants, they each started trials at relatively high rates: 1500 to 2000 ppm IBA as Hortus IBA Water Soluble Salts. Over time they found satisfactory results using lower rates.

Winter hardy perennial and woody ornamental plants have almost the same target rates:

- Perennial plants at 250 to 1500 ppm IBA.
- Woody ornamental plants at 350 to 1500 ppm IBA.

Rates were established using Hortus IBA Water Soluble Salts (Yoder: Pamela Schweizer, Grower – New Product Development, Aris- Green Leaf Plants, 2369 Old Philadelphia Pike, Lancaster PA 17602; Office #717-299-0300 ext 226. <Pam.Schweizer@glplants.com>. Bailey Nurseries: Sam Drahn, Director of Research, Bailey Nurseries, 1325 Bailey Road, St. Paul, Minnesota, U.S.A. 55119. <sam.drahn@baileynurseries.com>).

Annual Plants. For cuttings from annual and tropical plants, those plants that are not hardy or short season, the target rates are:

Annual and Tropical Plants at 80 to 250 ppm IBA. Higher rates may not cause permanent damage to the cuttings but they might get leaf curl or leaf spotting on the treated leaves. These effects are not permanent as the new leaf growth will be normal and there will be a high root mass. The effect is likely not caused by the rooting solution. Rather, the cuttings might have had inadequate stock plant preparation. Light and fertilization are needed before cuttings are taken to assure that they build up carbohydrates. Rates were established using Hortus IBA Water Soluble Salts.

Slow to Root Plants. Slow to root cuttings, planted in trays or pots, can be sprayed to improve root formation. Spray rates are similar to initial rates by the Spray Drip Down Method. To bring young rooted plants up to a uniform standard, Dutch growers use the spray drip down method at 50 to 100 ppm IBA, using Rhizopon AA Water Soluble Tablets at 1 to 2 tablets/L of water (Eigenraam, President, Rhizopon bv, Rijndijk 263A, Hazerswoude Holland <KeesEigenraam@rhizopon.com> Dates of discussions: June-October 2009).

WHEN AND WHEN NOT TO USE FOLIAR APPLICATION

Plants not suitable to be treated by foliar methods are leafless cuttings and winter dormant cuttings. Yoder and Bailey both found that about 15% of leafy cuttings in the growing season are not suitable to propagate by foliar methods. Suitability of plants is variable based upon reasons such as the season, taxon, condition of the stock plant before taking cuttings, and storage conditions. Sometimes the plants are better propagated by basal methods such as the basal quick dip, basal long soak, and the basal dry dip methods (Kroin, 2009; Yoder: Pamela Schweizer, Grower – New Product Development, Aris- Green Leaf Plants, 2369 Old Philadelphia Pike, Lancaster PA 17602; Office #717-299-0300 ext 226. <Pam.Schweizer@glplants.com>. Bailey Nurseries: Sam Drahn, Director of Research, Bailey Nurseries, 1325 Bailey Road, St. Paul, Minnesota, U.S.A. 55119 < sam.drahn@baileynurseries.com>).

DISCUSSION

L.H. Bailey was correct to say, when propagating plants you must use the full potential of the plant itself. Due to lack of technology in L.H. Bailey's time propagation from cuttings was not widely performed, especially on woody plants. Whatever propagation method he suggested to use, his goal was to use a stock plant that "is vigorous, free from disease or blemishes, and that possesses the characteristics of that variety." These "first class" plants are well grown, mature, and of the proper age for propagation (Bailey, 1896).

Kees Eigenraam says, "mother plants only produce easy-to-root cuttings when they are biologically and physiologically young" (Kees Eigenraam, President, Rhizopon bv, Rijndijk 263A, Hazerswoude Holland <KeesEigenraam@rhizopon.com> Dates of discussions: June-October 2009).

L.H. Bailey and Eigenraam are correct in their view to select the very best plants, at the proper time, to achieve successful propagation.

- Using their potential, plants produce the natural root forming substance IAA, auxin, in their leaves and other parts.
- Bio-simulators of IAA are IBA and NAA. For propagation from cuttings, during the growing season, leafy plants can accept aqueous rooting solutions through their leaves though pores called stomata.
- Aqueous rooting solutions contain free auxins that are active and can move within the plant. They move cell to cell, from the leaves to the basal end, where they accumulate.
- They move cell to cell, from the leaves to the basal end, where they accumulate.
- At the basal end the plant self regulates the use of the stored auxins for root initiation and other processes.
- The Spray Drip Down and Total Immerse Methods have been shown to be useful to apply these rooting solutions to leaves.
- When using foliar methods at the proper time, the plant uses its ability to form new roots by utilizing natural and applied auxins.

TRIAL RATES

Water soluble IBA products used to make rooting solutions were selected because they are U.S.A. EPA registered for use by plant growers. Rates are based upon trials at many locations (including Hortus USA and Rhizopon users, and Yoder, Aris, and Bailey). Individual results may vary; trials are needed.

Trial rates for cutting types*	IBA ppm (using water soluble IBA)
Soft perennial cuttings	80–250
Annual cuttings, perennial cuttings	250–1500
Woody ornamental cuttings	350–1500

*Rates can be lower for juvenile cuttings

Conversion for Hortus IBA Water Soluble Salts used by Yoder, Aris, and Bailey Nurseries: 50 ppm as Water Soluble IBA = 1 Rhizopon AA Water Soluble Tablet per liter water = 250 mg Hortus IBA Water Soluble Salts per liter of water.

Typical annual plants propagated by the spray drip down and total immerse methods (ppm IBA-using Hortus IBA Water Soluble Salts, or Rhizopon AA Water Soluble Tablets).

Plant	IBA (ppm)
Pelargonium (geranium)	
sp. like *Balcon*	50–100
zonale	200–300
peltatum	300–400
Impatient, New Guinea	15–50
Fuchsia	15–50
Petunia sp.	150–200
some colors	200–300
Osteospermum	150–200
Verbena	200–300
Poinsettia	25–100

Typical herbaceous perennial plants propagated by the spray drip down and total immerse methods (ppm IBA-using Hortus IBA Water Soluble Salts, or Rhizopon AA Water Soluble Tablets).

Plant taxa	IBA (ppm)
Abutilon	750
Achillea	up to 1000
Ajuga	up to 1000
Amsonia	1500
Anisodontea capensis 'Tara's Pink'	750
Antennaria	up to 750
Anthemis	1000
Arabis blepharophylla and *caucasica*	500
Armeria	1000
Artemisia	up to 500
Baptisia	3500
Basal kasar (*Ocimum basilicum* 'Kasar')	500
Calamintha sp. 'Variegata'	500
Campanula	500–1000
Ceratostigma	1500
Chrysanthemum	500–1000
Chrysogonum	750
Clematis	1000

Coleonema	750
Convolvulus	750
Coreopsis	500–1000
Correa	500
Cosmos	1000
Delosperma	1000
Erigeron	750–1000
Erodium 'Dark Eyes'	750
Erysimum	750
Eupatorium	500
Euphorbia	1000
Gaillardia	500
Galium	1500
Geranium	1000
Geum rivale	1000
Gypsophila paniculata 'Viette's Dwarf'	1000
Helenium	500
Helianthemum	2000
Helianthus	1000
Helichrysum	500–1000
Heliopsis	1000
Hypericum	1000
Hyssopus officinalis 'Pink Delight'	500
Iberis	1000
Lamium galeobdolon 'Herman's Pride'	1000
Lamium	up to 1000
Lavandula	1000
Linaria	500
Lithodora	2000
Lychnis	1000
Melissa	up to 500
Mentha	500
Nepeta	500
Oenanthe	500
Origanum	500–750
Origanum vulgare 'Compactum'	500
Penstemon	500
Persicaria	up to 1000
Phlox	1000
Phygelius	750

Poinsettia (*Euphorbia pulcherrima*)	500–1000
Polemonium yezoense var. *hidakanum* 'Polbress', Bressingham Purple™ Hakkaido Jacob's ladder	1000
Prunella grandiflora 'Loveliness'	750
Rosmarinus	500
Rudbeckia	750
Ruellia	1000
Salvia	500–1000
Santolina	500
Saponaria	1000
Saxifraga	750
Scabiosa	1000
Silene	500
Solly Boddy's Choice	750
Spilanthes	500
Stachys	1000
Teucrium	1000
Verbascum	1000
Verbena	750
Vinca	1000
Viola	1500
Waldsteinia	1000
Westringia	750

Typical woody ornamental plants propagated by the spray drip down and total immerse methods (ppm IBA-using Hortus IBA Water Soluble Salts, or Rhizopon AA Water Soluble Tablets).

Plant taxa	IBA (ppm)
Acer	1000–1500
Actinidia kolomikta 'Arctic Beauty'	1000
Arctostaphylos	500
Buddleja	1000
Callicarpa	500
Caryopteris	1000
Ceanothus	500
Cistus	750
Clethra	1000
Cotoneaster sp.	500–750
Cotoneaster × *suecicus* 'Coral Beauty'	500
Diervilla	500–750

Escallonia 'Compakta'	500
Hedera	1000
Hydrangea including, *H. paniculata*	500–750
Itea virginica 'Sprich', Little Henry® sweetspire	1000
Juniperus horizontalis	1000–1500
Kerria	1000
Leptospermum	500
Lonicera	1000
Paxistima canbyi	1000
Physocarpus opulifolius	1000–1500
Rhus	500–750
Rosa selections	1000–1500
Spiraea sp.	1000
Spiraea japonica	500–750
S. japonica 'Goldflame'	1000–2000
S. japonica 'Walbuma', Magic Carpet™ Japanese spirea	1000–2000
S. japonica 'Neon Flash'	1000–2000
Stevia rebaudiana	500
Syringa	500–750
Thuja	up to 1500
Viburnum	1000–1500
Vitex	1000
Weigela	1000–1500

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[NOTE: Reference is made to Yoder-Greenleaf Perennials. In October 2008, Syngenta bought Yoder's mum and aster business and the Yoder brand name. In July 2009 Yoder Brothers began using the name Aris. Green Leaf Perennials is now called Green Leaf Plants. see Pamela Schweizer.]
Bailey Nurseries: Sam Drahn, Director of Research, Bailey Nurseries, 1325 Bailey Road, St. Paul, Minnesota, U.S.A. 55119 <sam.drahn@baileynurseries.com>
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